Minimum Requirements for Protective Clothing in Animal Facilities

Although research using animals entails some real and unavoidable risks, the goal of protective programs is to enable animal based research to go on in a safe and productive environment. Our goal is to provide a set of principles that can be applied to a variety of animal facilities. Two principles are at the base for all protective measures: accident avoidance based on understanding the physical risks entailed, as exemplified by avoiding bites, scratches and kicks; and good personal hygiene based on knowledge of when contamination is most likely to occur, methods of avoidance and methods of decontamination, as exemplified by proper use of barrier methods and good hand washing practices.

For a protective program to be effective, workers must believe that the recommendations that are in place increase their safety significantly. The most important preventive strategy is education. Vigilance in animal handling, specific training of scientists and handlers in techniques for safe interaction with animals, proper use of protective clothing and equipment, and hand washing should be stressed. Any preventive measures that are put in place must be accompanied by an educational process that instructs all animal workers in the methods and rationale for each preventive measure. Protocols for emergency diagnosis and treatment of injury, especially possible Cercopithecine herpesvirus type-1 infection should be worked out ahead of time and all personnel instructed in their use. Workers who are knowledgeable about the risks and the protection offered by each device, article of clothing, and procedure should enthusiastically cooperate with the protection program.

All persons having direct contact with, or significant exposure to animals in the course of conducting research, and all persons providing animal care must participate in the NIH Animal Exposure Surveillance Program. This program classifies employees according to the species of animals to which they are exposed and provides appropriate surveillance and prophylaxis to these employees. Employees immunosuppressed by virtue of disease or treatment should be advised of their increased risks and should limit their exposure to animals.

These requirements are not meant to cover all of the specific instances that might be encountered, or to limit the requirements of any facility, but to provide a framework of minimum standards for implementing a program tailored to the local conditions. Specific recommendations for a safe environment must be formulated to account for local conditions, and these may vary from one laboratory to the next even within a single facility. Facilities conducting infectious disease research or those housing pathogen-free or immuncompromised animals may well have more stringent requirements in order to protect personnel and animals, respectively. Exceptions to any of these requirements may be requested of the IC ACUC with scientific justification. (An example might be a request for exemption from the face mask requirement for certain behavioral protocols using nonhuman primates.) However in these instances individuals must demonstrate adequate training and proficiency in appropriate techniques and the Division of Safety must concur with the exceptions. The NIH Institutional Biosafety Committee (IBC) will serve as the final review body, as needed.

A list of definitions of terms as well as tables listing specific zoonotic organisms and minimum requirements for protective clothing are included. The tables are organized according to four main groups of laboratory animals: rodents, nonhuman primates, carnivores and ungulates.

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Definitions[1]:

Uniform - Clothing assigned for use only in the animal facility. It cannot be worn outside the animal facility without appropriate covering.

Street clothes covering - A garment such as a lab coat or coveralls, worn to protect street clothes from contamination. This garment should not be worn outside the animal facility. A uniform may be substituted for a covering garment.

Light gloves - Vinyl or latex gloves which prevent contamination of skin by wet or dirty surfaces.

Arm length bite protection gloves - Heavy, reinforced gloves, usually of leather or similar material. The sleeves of these gloves should extend up to or over the elbows offering protection of the hands and forearms. These gloves do not necessarily prevent an animal from biting or causing injury; however, they usually prevent the bite from breaking the skin.

Mucous membrane protection - A device or combination of devices, such as face shields, surgical face masks combined with protective glasses or goggles, etc., which protect the mouth nose and eyes from splash or droplet contamination.

Shoe covering - Stretch booties, usually made of paper or plastic, worn over street shoes to protect them from contamination. These should not be worn outside the animal facility. Dedicated footwear may be substituted for shoe coverings. If dedicated shoes are worn, shoe coverings may be used to cover them when moving outside the facility.

Hand washing - The single most important method in the prevention of the spread of disease to animals and staff is handwashing (Larson 1988). Multiple studies have demonstrated that handwashing decreases the risk of oral intake of fecal and oral infective agents. Workers should wash their hands before and after coming into contact with animals. It is not clear that specific antibacterial handwashing agents are better than ordinary soap and water. It should be emphasized that even respiratory diseases are most likely transmitted hand to mouth rather than aerosol to lung, and that handwashing attacks this route.

1 The Division of Safety establishes the requirements for the proper use of protective clothing.

NONHUMAN PRIMATES

HAZARDS TO PERSONNEL:

Zoonotic Diseases:

Nonhuman primates and humans are similar enough that many of the same agents that cause disease in one species cause disease in the other, and dissimilar enough that agents relatively asymptomatic in one species can devastate the other (Brack 1987). Cercopithecine herpesvirus-1, tuberculosis, and various enteric infections are some of the more common zoonoses associated with nonhuman primates. Table 1 outlines some of the bacterial, viral, and other agents respectively that are transmissible from monkeys to humans and vice versa.

Wounds:

All animal procedures should be performed by properly trained personnel, with a vigilant approach to the prevention of bites and scratches, both for the minimization of physical damage and the prevention of disease transmission, especially Cercopithecine herpesvirus-1. Proper sleeves, eye protection, and appropriate gloves should be worn when scratches and bites are possible. All facilities should have appropriate standard operating procedures for first aid of wounds. All wounds should be reported to OMS.

PROTECTIVE MEASURES:

Table 2 outlines recommendations for specific activities associated with different risks of exposure. The guidelines assume that nonhuman primates have passed through an appropriate quarantine.

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RODENT AND RABBIT SPECIES

HAZARDS TO PERSONNEL:

Zoonotic Disease:

Zoonotic disease associated with modern rodent and rabbit research holding facilities is infrequent in incidence. Lymphocytic Choriomeningitis Virus (LCM), Korean Hemorrhagic Fever caused by Hantaan virus, Leptospirosis, the tapeworm Rodentolepis nana, and ringworm are some of the diseases reportedly acquired from rabbits and rodents in laboratory facilities. Most human infections have resulted directly from contact with the animals, their feces or urine, or indirectly by inhaling dried excreta carried on aerosolized dust. Table 3 lists some of the agents that are transmissible from rodent and rabbit species to humans.

Attention to hygiene, to include use of disposable gloves, frequent changing of gloves, careful handwashing, and use of facemasks will aid prevention of zoonotic disease associated with rodent and rabbit species.

Allergy:

Allergic skin and respiratory reactions are quite common in personnel working with laboratory animals. Hypersensitivity reactions to animal allergens are serious occupational health problems that develop in many individuals after repeated exposure. Hypersensitivity reactions include nasal congestion, rhinorrhea, sneezing, itching of the eyes, asthma and a variety of skin manifestations such as localized itching and flaking skin. Of the species used in biomedical research, the guinea pig, rabbit, mouse and rat appear to be the most allergenic. Urinary and salivary proteins in dust from animal holding rooms are probable allergens.

Methods of prevention include reduction of direct animal contact time, use of biological safety cabinets, filter tops on animal cages and protective clothing, masks, or respirators when working with these species. The dust and mist respirator has been found to be extremely effective in minimizing exposure to these dust borne allergens. Individual concerns should be discussed with OMS or a personal physician.

Wounds:

Training in proper handling and restraint of rabbits and rodents is the single most effective measure in protecting personnel from bites and scratches from these species. Other than the reported incidence of rat bite fever, the frequency and severity of bites resulting from rabbits and rodents appears to be minimal. Protective equipment such as the Whizard Handguard glove made from Kevlar and the N-Dex Soft-Nitrile Glove may be indicated when working with rabbits and rodents inoculated with hazardous materials that may be shed in the saliva. All facilities should have appropriate standard operating procedures for first aid of wounds. All wounds should be reported to OMS.

Table 4 outlines specific recommendations for specific activities associated with different risks of exposure.

References:

Beran, G.W. (1994) Handbook of Zoonoses, 2nd ed., Sections A & B, CRC Press, Boca Raton, FL.

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CARNIVORE SPECIES

HAZARDS TO PERSONNEL:

Zoonoses:

The most commonly used carnivores in the laboratory are dogs, cats and ferrets. Rabies is the most significant zoonotic disease associated with carnivores. A number of parasitic organisms are also of concern. Table 5 lists some of the agents transmissible from carnivores to humans.

Special concerns are:

a. Personnel who work with carnivores must be made aware that they are potential vectors for the transmission of infectious agents between their own carnivore pets and laboratory animals of the same or similar species.

b. Asplenic and/or immunocompromised individuals are at increased risk of developing severe complications from bite/scratch wounds of dogs and cats: see below for specific incriminated organisms.

Wounds:

Bite wounds must be emphasized as the most important source of possible zoonotic disease transmission and injury to the laboratory worker. All facilities should have appropriate standard operating procedures for first aid of wounds. All wounds should be reported to OMS.

Table 6 outlines specific recommendations for specific activities associated with different risks of exposure.

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UNGULATE SPECIES

HAZARDS TO PERSONNEL:

Zoonotic Disease:

Zoonotic disease associated with ungulate holding facilities is limited, especially when the animals are kept in closed herds with proper vaccination and herd health programs. The possible zoonoses are listed in Table 7 and can result from aerosol exposure, ingestion, or direct contact with infected ungulates or their wastes.

Allergies:

Allergies to ungulates have been reported, but are less common than those to small laboratory animals.

Wounds:

Because of the size of these species, injuries from being stepped on, kicked or butted can result from improper handling and restraint. Bite wounds may also occur. Training in proper use of halters, ropes and other restraint equipment is recommended. Wounds occurring when handling ungulates should receive proper, immediate disinfection, and should be reported to OMS. Tetanus toxoid should be administered at 10 year intervals and at the time of wound treatment.

Table 8 outlines specific recommendations for specific activities associated with different risks of exposure.

REFERENCES

Beran, G.W. (1994) Handbook of Zoonoses, 2nd ed., Sections A & B, CRC Press, Boca Raton, FL.

Chin, J. (2000) Control of Communicable Diseases. American Public Health Association, Washington, DC.

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Occupational Health and Safety in the Care and Use of Research Animals (1997) Institute of Laboratory Animal Resources, Commission on Life Sciences, National Research Council.

Table 2 - Protective Clothing Requirements for Personnel in Nonhuman Primate Facilities

ACTIVITY	REQUIREMENTS
View animals in the primate room. No contact with the animals or the cages	Mucous membrane protection as appropriate* and street clothes covering, hand washing should be performed upon leaving the area and after any of the following activities.
Contact with a restraint device holding an awake animal	Mucous membrane protection as appropriate*, street clothes covering and light gloves.
Transfer alert monkey using a stand-off method such as pole/collar technique or transfer cage	Mucous membrane protection as appropriate*, street clothes covering and light gloves.
Handling (e.g. hand catching or restraining) of an alert monkey.	Mucous membrane protection appropriate for high risk situations, street clothes covering and arm length bite protection gloves.
Physical contact with an anesthetized monkey.	Mucous membrane protection as appropriate*, street clothes covering and light gloves.
Cleaning cages.	Mucous membrane protection appropriate for high risk situations, dedicated clothing, dedicated shoes, and light gloves; dust-mist masks, if approved by OSHB, DS.
Physical contact with restrained alert monkey	Mucous membrane protection as appropriate*, street clothes covering and light gloves.
Physical contact with infant monkeys	Mucous membrane protection as appropriate*, street clothes covering and light gloves. As infants mature, heavier gloves may be required.
Perform portions of experiments in a laboratory that do not involve physical contact with monkey or body fluids.	Protection appropriate for non-animal aspects of research.
Handling awake New World Species	Mucous membrane protection as appropriate*, street clothes covering, protective gloves appropriate for the species and size of animal being handled. Larger species such as Cebus should be handled with the arm length bite protection gloves, while very small species such as marmosets may be handled with lighter weight protection.

* Mucous membrane protection should be appropriate to the potential for splash hazard. The level of mucous membrane protection should be detailed in facility standard operating procedures (SOP's). SOP's are subject to review and approval by the IC ACUC with the concurrence of the Division of Safety with consult by the IBC as necessary. The degree of risk involved in entering an animal holding room or working with awake animals varies with the design of the facility, the species involved and the nature of the task being performed. **Examples** of high risk situations include any procedures which may aerosolize NHP wastes or body fluids, e.g. hosing down animal rooms, dental work or tracheal intubation, especially of macaques. Lower risks are associated with fully restrained animals, anesthetized animals (However, Ketamine increases salivation which is a major source of potential B virus contamination from macaques), and increased distance from animals. In very low risk situations, e.g. entering hallways through which animals in restraint devices may briefly pass, mucous membrane protection may not be required. The future definition and availability of SPF animals may alter these requirements.

Table 1 - Zoonotic Diseases of Nonhuman Primates

Zoonosis	Agent	Route of Transmission
Diarrhea; gram negative sepsis	Enterobacteriaceae: *Salmonella spp., Shigella spp., Campbylobacter spp. Escherichia spp.*	**Fecal-oral;** best prevented by careful handwashing; especially hazardous to immunocompromised individuals.
Pneumonia; skin and other abscesses; pharyngitis with immunological sequelae; endocarditis and septicemia.	Gram positive cocci: *Staphylococcus spp., Streptococcus spp.*	**Oral, parenteral,** best prevented by careful hand washing; hazardous to immunocompromised and splenectomized individuals.
Tuberculosis	*Mycobacteria spp.*	**Aerosol;** best prevention is aggressive TB surveillance program. Masks may lower probability of human to monkey transmission.
Herpes B Virus Encephalitis	Cercopithecine herpesvirus-1 (formerly Herpesvirus simiae)	**Bite, scratch, splash exposure of mucous membranes.** A minority of cases without documented route of exposure. Late recrudescence of dormant infection reported in one case. Aerosol transmission has not been documented. Prevention: Avoidance of contact with macaque saliva. Careful restraint; vigilance; protocols for dealing with scratches and bites established in advance. High index of suspicion in cases of idiopathic febrile illness in animal workers.
Viral Multifocal Leukoencephalopathy	Papova viruses including SV 40	Only of concern in immunosuppressed individuals.
Hepatitis	Hepatitis B virus (HBV, Hepadnaviridae) Hepatitis A virus (HAV, Picornaviridae)	**Parenteral inoculation** (HBV). Sharps precautions, vaccination possible. **Fecal-oral** (HAV).

Table 1 Cont. - Zoonotic Diseases of Primates

Zoonosis	Agent	Route of Transmission
Measles	Rubeola virus	**Aerosol.** Immunization of monkeys and workers recommended.
Monkeypox, Yaba, BEMP	Pox viruses	**Direct contact.**
Polio	Polio virus	**Fecal-oral.**
Retrovirus infection (Possible immunosuppression)	Simian immunodeficiency virus (SIV)	**Parenteral inoculation, possibly mucous membrane contamination.** Sharps precautions, gloves
Influenza	Paramyxoviruses	**Fecal-oral, respiratory.**
Dermatomycosis (Ringworm)	*Trichophyton spp.*	**Direct contact.**
Histoplasmosis	*Histoplasma capsulatum*	**Aerosol** from contaminated soil.
Cryptococcosis meningitis	*Cryptococcus neoformans*	**Aerosol** from contaminated soil. Immunologically compromised humans are especially vulnerable.
Pneumocystis carinii infection	*Pneumocystis carinii*	**Aerosol.** Only of concern in immusuppressed individuals.
Amoebic Dysentery	*Entamoeba histolytica*	**Fecal-oral.**
Malaria	*Plasmodia spp.*	**Arthropod borne.**

Table 3 - Zoonotic Diseases of Rodents and Rabbits

Zoonosis	Agent	Species	Route of Transmission
Rat Bite Fever	*Streptobacillus moniliformis, Spirillum minus*	Rodents	**Bites, fecal-oral** (*S. moniliformis*) **Bites** (*S. minus*)
Leptospirosis	*Leptospira spp.*	Rodent/Rabbit	**Aerosol**, **direct contact** with urine, water or soil.
Lymphocytic Choriomeningitis	LCM virus	Rodents	**Aerosol, bites, direct contact, fecal-oral.**
Korean Hemorrhagic Fever	Hanta viruses	Rodents	**Aerosol, direct contact, fecal-oral**
Cheyletiellosis	Cheyletiella parasitivorax	Rabbit	**Direct contact**
Dermatophytosis (Ringworm)	*Trichophyton sp.* *Microsporum sp.*	Rodent/Rabbit	**Direct contact**
Tapeworm	*Hymenolepis nana*	Rodents	**Fecal-oral**
Pneumocystis carinii Infection	*Pneumocystis carinii*	Rodent/Rabbit	**Aerosol**

Table 4 - Protective Clothing Requirements for Personnel in Rodent and Rabbit Facilities

ACTIVITY	REQUIREMENTS
Enter Animal Holding Room for Brief Visual Inspection	Street clothes covering or uniform, handwashing should be performed upon leaving the area.
Contact with Primary Enclosures and/or Direct Contact with Animals	Same as above. If any infectious disease is suspected, gloves should be worn.
Cleaning	In addition to the protection listed above, a surgical type face mask should be worn.

Table 5 - Zoonotic Diseases of Carnivores

Zoonosis	Agent	Species	Route of Transmission
BACTERIAL ORIGIN:			
Brucellosis	*B. Canus*	Dog	**Direct contact** with bodily fluids
Campylobacteriosis	*Campylobacter jejuni*	Dog [1] Cat Ferret	**Ingestion** **Fecal/oral**
DF-2 Infection	Capnocytophaga *canimorsus*	Dog Cat	**Direct contact** **Bite, scratch**
Leptospirosis	*Leptospira canicola* *L. hardjo*	Dog	**Aerosol, direct contact** with water, urine
Listerosis	*Listeria sp.*	Ferrets	**Direct contact** **Cutaneous**
Lyme Disease	*Borrelia burgdorferi*	Dog Tick	**Tick bite**
Pasteurellosis	*Pasteurella multocida*	Dog Cat	**Direct contact, bite** **scratch, inhalation**
Plague	*Yersinia pestis*	Cat Dog Coyote	**Direct contact, flea,** **scratch, bite,** **tissue** handling
Staphyloccus	*Staphyloccus sp.*	Dog	**Direct contact**
RICKETTSIAL ORIGIN:			
Ehrlichiosis	*Ehrlichia canis*	Dog	**Direct contact, tick**
Cat-scratch Fever	*Bartonella henselae*	Cat	**Bite, scratch**
Rocky Mountain Spotted Fever	*Rickettsia rickettsia*	Cat Dog	**Direct contact, tick**
VIRAL ORIGIN:			
Rabies	*Rabies virus*	All	**Wound** or **bite** **Contact** with saliva, brain
Reo and Rota Virus Diarrhea	*Reo and Rota Viruses*	Dog Cat	**Fecal/oral**

[1] especially puppies, kittens with diarrhea

Table 5 Cont. - Zoonotic Diseases of Carnivores

Zoonosis	Agent	Species	Route of Transmission
MYCOTIC ORIGIN:			
Dermatomycoses (Ringworm)	*Microsporum sp.* *Trichophyton sp.*	Dog	**Direct contact**
Pneumocystis Carinii Infection	*Pneumocystis carinii*	Dog Cat	**Aerosol**
PARASITIC ORIGIN:			
Acariasis	*Sarcoptes scabei*	Dog Cat	**Direct contact**
Ascariasis (Visceral Larva Migrans)	*Toxicara canis* *T. cati*	Dog Cat	**Fecal/oral**
Cutaneous larval Migrans	*Ancylostoma caninum* *A. brazilense, A. uncinaria*	Dog Cat	**Direct contact**
Flea Bite Dermatitis	*20 species of fleas*	All	**Direct contact** with flea
Toxoplasmosis	*Toxoplasma gondii*	Cat	**Fecal/oral**

Table 7 - Zoonotic Diseases of Ungulates

Zoonosis	Agent	Species	Route of Transmission
Q Fever	*Coxiella burnetti*	Sheep Cattle Goats	**Aerosol,** **Direct contact**
Tuberculosis	*M. bovis* *M. avium* *or* *M. tuberculosis*	Swine Sheep Goats	**Aerosol,** **Direct contact**
Contagious Ecthyma (ORF)	*Pox virus*	Sheep Goats	**Direct contact**
Dermatophilosis	*Dermatophilus congolensis*	Horses Cattle Sheep Goats	**Direct contact**
Erysipeloid	*Erysipelothrix rhusiopathiae*	Swine Sheep Cattle	**Direct contact**
Balantidiasis	*Balantidium coli*	Swine	**Fecal/oral**
Tetanus	*Clostridium tetani*	Cattle Sheep Goats Horses	**Wound**
Actinomycosis	*Actinomyces bovis*	Cattle	**Wound**
Brucellosis	*Brucella abortus,* *B. suis, or* *B. melitensis*	Cattle Sheep Goats Swine Horses	**Direct contact** with body fluids, **Aerosol**
Leptospirosis	*Leptospira interrogans*	Swine Cattle	**Aerosol**

Table 7 (Continued) - Zoonotic Diseases of Ungulates

Zoonosis	Agent	Species	Route of Transmission
Campylobacteriosis	*Campylobacter jejuni*	Swine Sheep Cattle	**Fecal/oral**
Dermatomycoses (Ringworm)	*Trichophyton,* *or Microsporum spp.*	Cattle Sheep Goats Swine	**Direct contact**
Trichostrongylosis	*Trichostrongylus axei, or* *T. colubriformis*	Cattle Sheep Goats	**Fecal/oral**
Flea Infestation	*Pulex irritans*	Swine	**Direct contact**
Anthrax	*Bacillus anthracis*	Cattle Sheep Goats Horses Swine	**Aerosol** from blood or contaminate materials, **Contamination** of wound or broken skin

Table 6 - Protective Clothing Requirements for Personnel in Carnivore Facilities

ACTIVITY	REQUIREMENTS
Entry into Animal Rooms	Street clothes covering.
Entry into Animal Runs or Pens	Street clothes covering and shoe covers.
Direct Contact with Animals	In addition to above, hand washing should be performed upon leaving the area. If any infectious disease is suspected, gloves should be worn.

Table 8 - Protective Clothing Requirements for Personnel in Ungulate Facilities

ACTIVITY	REQUIREMENTS
Entry into Animal Holding Areas	Dedicated shoes, disposable shoe covers or rubber work boots which can be disinfected should be worn upon entering the animal pens, runs or stables. Uniforms, lab coats or coveralls should be worn to protect street clothing. Hand washing should be performed upon leaving the area.
Direct Contact With Animals Which Have Completed an Appropriate Quarantine or Conditioning Program	In addition to the protection listed above, disposable gloves should be worn if any infectious agents are suspected.
Handling newly acquired animals whose health status may not be well defined	In addition to the protection listed above, light gloves should be worn. Handling sheep of unknown Orf/ Soremouth status is a documented risk and requires use of light gloves.
Contact with pregnant sheep\goats\cattle	In addition to the protection listed above, light gloves and a dust mist mask should be worn, if approved by OSHB, DS, when working with pregnant sheep, goat or cattle during parturition, their birth products, bedding and other wastes. (If animals are not Q-fever negative, they should be handled using Animal Biosafety Level 2 precautions.)